# 1
# General Requirements

### 1.0 Introduction

These specifications apply to the material and fabrication procedure for Road Guide, Highway Guide, Pathfinder, Boundary Signs, and MUTCD Regulatory Signs.

Great care was given to developing a system that will be durable and, where possible, follow the NPS principles of sustainable design, while being compatible to various park environments.

Signs assemblies are fabricated to the dimensions specified in the sign orders and these specifications. They are ordered from the sign schedule and mounted with Douglas Fir Select Grade dimensional timber uprights. Work shall include the furnishing of all materials, labor, equipment, and supplies to construct sign panels or full sign assemblies, packaging, and shipment to the designated assembly location.

### 1.1 Function

These specifications are provided as a guideline for the fabrication, assembly, and installation of Motorist Guidance signs for the UniGuide Program of the National Park Service. Material and fabrication specifications are provided for each structure and related graphic panels.

All signs are to be built to the specifications described in this chapter. Additional instructions and requirements are to be provided within contracts that describe the performance of specific sign fabricators and suppliers.

### 1.2 Scope

Signs and sign assemblies are to be manufactured using materials and fabrication processes as described in these specifications and companion drawings, and match quality of initial submissions.

### 1.3 Identification Systems

Each sign type, format, size, assembly, and material is identified by the following code:

**Roadway Sign Grid Formats**

| | |
|---|---|
| RG-1 | Road Guide Sign for Single and Multiple Destinations without Symbols |
| RG-2 | Road Guide Sign for Single and Multiple Destinations with Symbols |
| RG-3 | Road Guide Sign for Single and Multiple Destinations with route shield |
| RG-4 | Road Guide Sign for Single and Multiple Destinations with 2 to 3 Route Shields |
| RG-5 | Road Guide Sign for Single Destination with 2 to 4 Symbols |
| RG-6 | Road Guide Sign for Single and Multiple Destinations with Distance |
| RG-7 | Road Guide Sign for Single Destination with 1 or 2 Symbols |
| RG-8 | Road Guide Sign with 1 to 4 Symbols and Directional Arrow |
| RG-9 | Road Guide Information Sign for Single Destination with Secondary Legend |

| | |
|---|---|
| RG-10 | Road Guide Sign for Single Destination with Advance Guidance |
| RG-11 | Road Guide Sign with Advisory Legend Panels Highway Guide Sign Grid Formats |
| HG-1 | Highway Guide Sign with 1-3 Line Legend with Directional Arrow |
| HG-2 | Highway Guide Sign with 1-3 Line Legend, Advance Guidance and NPS Arrowhead |
| HG-3 | Highway Guide Sign with 1-3 Line Legend and Advance Guidance |
| HG-4 | Highway Guide Sign with 1-3 |

### 1.4 Dimensions

Dimensions for legend size and all related dimensions for sign layout, panel sizes, post lengths, mounting height, and post drilling for connection of panel to post, hardware, machine parts (connection details), and materials (dimensional lumber and panel thickness) are specified in inches.

### 1.5 Installation Sticker

All finished sign panels shall be provided with a 1-1/4" x 2-1/2" weather resistant identification placed on the back of the sign indicating sign plan ID number, manufacturer, date of fabrication, and installation date.

### 1.6 Reference Standards

#### 1.6.1 Motorist Guidance

- Manual on Uniform Traffic Control Devices (MUTCD), Millennium Edition, by the U.S. Department of Transportation, December 2000
- Traffic Control Devices Handbook, by the U.S. Department of Transportation, FHWA, 1983
- U.S. Department of Transportation, Federal Highway Administration, Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects, current edition FP-85 Sections 633.06 and 718.01
- General Services Administration., Federal Supply Service specification L-S-300-C
- American Society for Testing and Materials standard specification for Aluminum and Aluminum Alloy Sheet and Plate (ASTM- 6061-T5 extruded shape, and 2024-T3, 3003-H16, 3003-H14, 6061-T6, and 5052-H34 aluminum plate)
- American Society for Testing and Materials standard specification for Retroreflective Sheeting for Traffic Control, ASTM D-4956-93a
- Western Wood Products Association Design Stress for Graded Lumber (Douglas Fir Select Grade)

### 1.6.2 MUTCD Regulatory Sign Mounting

- Manual on Uniform Traffic Control Devices (MUTCD), Millennium Edition, by the U.S. Department of Transportation, 2000
- Traffic Control Devices Handbook, by the U.S. Department of Transportation, FHWA, 1983
- American Society for Testing and Materials standards for Weathering Steel ASTM-588 (A-847 as a tube product)

## 1.7 Graphic Standards

All graphic formats, use of typography, color, directional arrow graphics, pictograms and NPS Arrowhead logo shall comply without deviation from the Graphic Standards illustrated in Chapter 2. All exceptions must be approved in writing by the NPS UniGuide Program Manager based on a graphic submission submitted for review.

## 1.8 Structural Engineering

All structures shall be engineered to meet a variety of site conditions. Signs shall be engineered for wind loads, soil conditions, frost depth, and structural integrity. Special conditions that are outside these parameters are to be engineered on a site-specific basis. The design of the structural requirements of special one-of-a-kind signs shall conform to the basic assembly specifications for similar sign types. The modified assembly shall fulfill the requirements of local criteria for wind pressure, soil, and frost depth.

## 1.9 Quality of Materials

All materials shall be new and of first quality. Materials shall meet or exceed the standards and specifications herein or by reference. Factory seconds shall not be accepted. All materials shall comply with this specification or approved equal.

## 1.10 Mounting Regulations for Frangible Bases

Sign assemblies will be embedded in concrete footings. Where appropriate use of bases that will break away upon impact are encouraged. The sign upright can be modified to incorporate a breakaway base as per the FHWA Traffic Control Devices Handbook (Part II), the AASHTO Standard Specification for Structural Supports for Highway Signs, Luminaire and Traffic Signals (Chapter 5), the AASHTO Roadside Design Guide (and as incorporated into the NPS Sign Manual 1988), and the NCHRP Recommended Procedures for the Safety Performance Evaluation of Highway Features (Report 350). Those guidelines are not included in this manual.  Other references include local highway sign specifications which may identify drilling procedures for timber posts.  Break away bases must be engineered for each

installation base on size of uprights, distance between uprights, panel height above grade level, and area of panel. Whenever possible, the guide sign should be mounted on a level grade. Use of breakaway bases are discouraged by the AASHTO standards when signs are mounted on an uneven grade in which calculation of impact point is not possible, or in pedestrian zones where an impacted sign may dislodge and hit a bystander.

### 1.11 Installation

Installation may include assembly and installation only, or assembly, installation and removal and disposal of existing signs.

### 1.12 Workscope

Contractor shall furnish all labor, materials, tools, equipment, loading/unloading and transportation services required to perform and complete the work according to the specifications and contract documents. All work shall be done with no damage to mounting site or sign.

### 1.13 Staging Area

If requested, the NPS will provide a lay-down and staging location for sign assembly and sign component storage during the installation process. Location will be in close proximity to the construction site but outside of areas that are actively used by park visitors. Contractor shall stay within designated area and not damage surrounding vegetation. Upon completion of installation project, Contractor shall remove all materials and restore area to preexisting condition. Securing the area will be the responsibility of the Contractor.

### 1.14 Footings Reference

For complete specifications on foundations and assembly, refer to the respective *Material Specifications and Assembly Drawings* in chapters 4 and 5 of this Volume.

### 1.15 Sign Location

All signs are to be mounted at locations as identified in the sign plan and approved by the COTR specified in the task order. Sign locations will be marked with  a stake. The stake shall have the sign type code, and location code, and correspond to the sign location plan drawings.

- Double post signs will be staked at the location of the left leg when facing the sign. Double-faced signs and angled installations will be staked with both leg locations noted.

- Double-post assembly stations will be identified using two stakes for the two posts of the primary installation with orientation of the assembly to follow location drawing.
- Campsite identification assemblies will be placed in the same location as existing identifiers unless noted otherwise.

The Contractor shall check and verify all dimensions and conditions at the job site prior to installation. Discrepancies are to be brought to the attention of the COTR for adjudication and resolution.

No land surveys are required. All survey and land data will be provided by the NPS and are not the responsibility of the contractor unless otherwise specified.

All sign engineering and structural integrity will be the responsibility of the contractor unless otherwise noted in contract documents.

### 1.16 Obstructions

Unforeseen obstructions may limit the depth of a standard footing or require special mitigation to prevent damage to existing tree roots. Where possible, move the sign as needed to allow unconstrained subsurface installation. If a sign placement location must be moved because of subsurface obstructions, the Contractor shall notify the COTR specified in the task order if such installation will not fit in this location. If the sign can be logically moved, verify sight-lines of adjusted locations to affirm that sign is still visible from the designated approach.

- If plant and tree obstructions are identified, and the sign location cannot be moved, see Section 1.18 in Chapter 5 for Tree/Plant Protection, and Mitigation of Damage.
- If the sign location cannot be moved and nonplant (rock) obstructions prohibit the footing from being as deep as specified, a shallow footing may be required.

The COTR specified in the task order will provide known existing condition data on utility line locations in conjunction with park engineering and maintenance operations and utility company surveys. Prior to beginning excavation, the Contractor shall notify Contract Officer and utility companies of proposed sign locations and times for excavation.

The Contractor shall be responsible for locating and preventing damage to known utilities. If damage occurs, the Contractor shall repair the utility at no additional expense to the Government.

### 1.17 Site Protection

The Contractor shall provide all necessary protection for his work until turned over to the COTR specified. The Contractor shall protect all adjacent structures, surfaces, vegetation and plant materials from damage during installation. The Contractor will notify the COTR **immediately** of any occurrence of damage. Any damage to the items described above must be restored to original condition and appearance, or replaced.

Confine all operations to work limits of the project. Prevent damage to natural surroundings. Restore damaged areas, repairing or replacing damaged trees and plants at no additional cost to the Government.

- Do not remove, injure, or destroy trees or other plants. Consult with COTR to remove agreed-on roots and branches, or whole branches or trees that interfere with sign installation.
- Do not fasten ropes, cables, or guys to existing trees.
- Carefully supervise excavating, grading, filling, and other construction operations near trees to prevent damage.

Minimize disturbance to tree trunks and root zones to prevent damage to trees.

- Do not drive over root zones unless work cannot otherwise reasonably be done. Driving over roots will compact the soil and can harm or destroy the tree.
- Do not pile excavated soil against tree trunks.
- Do not compact soil around roots to a greater degree than surrounding unexcavated soil except to meet compaction requirements for backfilling signpost installations.

### 1.18 Tree/Plant Protection

Do not remove, injure, or destroy trees, tree roots, or other plants without prior approval. Use accepted horticultural practices for all work. Adjust sign installation locations to keep them beyond the drip line wherever possible. Notify the COTR of any proposed sign locations within the drip line of the trees. The drip line shall be defined as the area below the farthest-spreading branches of a tree. Where such adjustments are not practical, maintain the following minimum clearances between the face of trees to be saved and the closest edge of sign footing:

- for trees more than 30’ in diameter allow 10 feet
- for trees between 15’ and 30’ in diameter allow 8 feet
- for trees less than 15’ in diameter allow 5 feet

### 1.19 Mitigation of Damage

Take steps to mitigate damage to roots wherever excavation must take place within the drip line of trees and wherever excavation must take place within the drip line of other trees 12 inches or larger in diameter:

- Excavate carefully where tree roots might be encountered. Where roots 2” and larger are encountered, hand excavate as required to prevent damage to roots. Tunnel under roots to be saved, hand excavating as necessary
- Do not cut roots over 2” in diameter.
- Cleanly saw cut roots between 1” and 2 “ in diameter where they interface with work; do not cut roots except as necessary. Roots between 1” and 2” in diameter which must be cut shall be cleanly saw cut near the edge of sign foundation closest to the tree to prevent roots from being dislodged from soil by equipment.
- Within four hours of excavating wrap burlap around the ends of cut roots larger than 1” in diameter and wet the burlap. Keep the burlap moist until the sign is backfilled. During backfilling operations, bring the burlap to within a few inches of the ground surface.
- Thoroughly wet roots and burlap in the excavated area before backfilling. Backfill shall contain as much water as is compatible with compaction.

### 1.20 Archeological Findings

Petroglyphs, artifacts, burial grounds or remains, structural features, ceremonial, domestic, and archeological objects of any nature, historic or prehistoric, found within the construction area are the property of and will be removed only by the Government.

### 1.21 Demolition

Sign to be replaced shall be removed completely by the Contractor following or in conjunction with installation of the new signs unless otherwise specified.

All designated existing signage and related structures shall be removed from the project area and disposed of properly in accordance with state and local regulations unless otherwise indicated.

### 1.22 Installation Quality

The Contractor shall install all signs level and plumb at the specified heights and alignments with all specified footings, backfill, or attachment hardware.

The Contractor shall remove all packing, sign boxes, and construction materials from the project upon completion of installation.

The Contractor shall replace damaged ground cover with same species as damaged in the installation process unless instructed otherwise in the installation specifications provided by the park.

# 2
# Materials Overview

### 2.0 Introduction

This section provides an overview of all material specifications for components used in the UniGuide Roadway system.

### 2.1 Aluminum Composite Panel Material

10 mm Omega Alumalite ACM (aluminum composite material) as manufactured by Laminators Inc., Hatfield, Pa., for Road Guide, Pathfinder and Boundary Sign panels

### 2.2 Dimensional Lumber

Douglas Fir (Pressure Treated): Structural Grade, Number 2 Standard and Better timbers pressure- treated with ACQ (Ammoniacal Copper Quat.). Do not use CCA treated material. Sizes include: 4" x 4", 4" x 6", 4" x 8", 4" x 10" ,6" X 8" and 8" X 10" with lengths specified in sign schedule for Road Guide, Pathfinder, and Boundary Signs.

### 2.3 Steel

#### 2.3.1 Pathfinder and Boundary Signs

1/4" thick (10" x 42", 12" x 42", 14" x 42") A-36 plate stabilizer blades with epoxy coating for direct embedment Pathfinder and Boundary Signs

#### 2.3.2 Traffic Regulatory Signs

Square (2" x 2" x 1/8") or rectangular (2" x 3" x 1/8") A–847 tubular sections weathering steel

### 2.4 Aluminum

#### 2.4.1 Road/Highway Guide Signs

3" x 2-1/2" x 1/4", 6061-T6 aluminum structural angle for matching "L" brackets attached to both panel and upright to create "Z" match plate

#### 2.4.2 Pathfinder/Boundary Signs

3" x 3" x 3/16", 6061-T6 aluminum structural angle for "L" brackets used to attach sign panel to upright

#### 2.4.3 MUTCD Regulatory & Warning Signs

0.125"–6061-T6 aluminum sheet

## 2.5 Hardware

### 2.5.1 Alumalite Panels

- 4” x 1/2” zinc plated steel dowel pins, (Laminators, Inc. No. 50292) for edge joining panels for sheets over 5’-0” x 10’-0”
- 1/2”, No.8 stainless steel pan head sheet metal screw (MC92465A194) for attachment of angle to Alumalite panel to secure during adhesive set.

### 2.5.2 Road/Highway Guide Signs

- 1/2”-13 dia. – 18-8 stainless steel hex bolts for attachment of aluminum angle to timber upright in lengths based on post size; 5”(MC 92198A732), 7”(MC 92198A738), 9”(MC 92198A742), 12”(MC 92198A748)
- 9/16”– 18-8 stainless steel washer for attachment of aluminum angle to timber upright (MC 98019A510)
- 1/2”-13 stainless steel hex nut for attachment of aluminum angle to timber upright (MC 91845A310)
- 3/8”– 16 x 1-1/4”– 18-8 stainless steel hex head for attaching companion aluminum angles (McMaster Carr 92240A626)
- 3/8”– 18-8 stainless steel flat washer for attaching companion aluminum angles (McMaster Carr 98019A500)
- 3/8”– 18-8 stainless steel flat spring lock washer for attaching companion aluminum angles (McMaster Carr 91475A031)
- 3/8”– 18-8 stainless steel hex nut for attaching companion aluminum angles (McMaster Carr 91845A031)

### 2.5.3 Pathfinder and Boundary Signs

- 1/4”– 20 x 4.5” stainless steel hex head 18-8 bolts for panel attachment with 4” post (McMaster Carr 92198A560)
- 1/4” stainless steel flat washer for attachment of angle bracket to post (McMaster Carr 98019A360)
- 1/4”– 18-8 stainless steel, hex head lock nut with Nylon insert (MC 91831A029)
- 1/2”– 13 zinc- plated steel hex bolts for attachment of stabilizer blade to timber upright. Sizes include: 5” (MC 91236A732), 7” (MC 91236A738), 9” (MC 91236A742) with companion galvanized washer
- 7/16” galvanized washers for attachment of sign brackets to timber upright (MC 98970A132)

### 2.5.4 MUTCD Regulatory & Warning Signs

- Panel and rail assembly bolts: 1/4–20 x 2-1/2” stainless steel truss head bolt
- Tamper resistant nuts: 1” X 1” x 1/4” Tuff Nut brand nut assembly
- Acorn nuts: 1/4–20 thread, stainless steel
- 1/4–20 x 2-1/2” aluminum stud welded to parking sign panel

### 2.6 Graphics

- Type I – A medium-intensity retroreflective sheeting referred to as “engineering grade” with Class 1 adhesive backing that is pressure sensitive per ASTM 4956-01 and FHWA standard specification FP-96
- Type II - A medium high-intensity retroreflective sheeting referred to as “super engineering grade” with Class I adhesive backing that is pressure sensitive per ASTM D4956-01 and FHWA standard specification FP-96
- Type III – A high-intensity retroreflective with prismatic retroreflective material with Class 1 adhesive backing that is pressure sensitive, per ASTM 4956-01 and FHWA-FP-96

Transparent overlay film reverse cut and applied to Type II and Type III sheeting shall be warranted by the reflective sheeting manufacturer for the life of the retroreflective sheeting. Translucent and opaque screen-printing inks applied to Type I and Type II sheeting shall be compatible with specified sheeting.

### 2.7 Fabrication

Wood posts may receive holes (drilled perpendicular to face of sign) to aid break away function. Hole drilling must be perfomed base on designs prepared by a qualified design engineer.

### 2.8 Paint and Coatings

#### 2.8.1 Road Guide, Pathfinder, and Boundary Signs

- Acrylic Gloss Enamel, Benjamin Moore M28, color 5/E-1000 for field painting of posts
- Matthews Pretreatment Acid Activated PT Filler (74760/74766) metal prep
- Matthews Acrylic Polyurethane enamel (number 39A-1A) with appropriate activator and catalysts (see manufacturer’s specifications); alternate: Matthews low volatile organic compound formula, available where environmental regulations require, for aluminum angles
- Bituminous roofing cement for coating directly embedded Road Guide, Pathfinder, and Boundary Sign upright timbers

#### 2.8.2 MUTCD Regulatory & Warning Signs

- Zinc chromate primer (Matthews Paint Company 74-734 with 74-735 activator, or equal)
- Acrylic polyurethane enamel: Rich Brown (Matthews Paint Company 42-224 with 43-270 catalyst or compatible Matthews VOC material, or equal)
- Rust inhibiting metal primer

### 2.9 Adhesive

Heavy duty exterior grade construction adhesive (Laminators, Inc. No. 12751), 11 oz. tube, for adhering aluminum angle to back of Alumalite panels of Road Guide Signs and Pathfinder and Boundary Signs.

### 2.10 Concrete

3000 lbs./28 days

# 3
# Panel Fabrication

### 3.0 Panel Fabrication Charts

Each Road Guide Sign is unique in that the size is based on the legend size (4", 6", 8"), the length of the longest legend line on a sign panel and overall height of the sign layout based on the standard grid formats (RG1 to RG-11, HG-1 to HG-4) as provided in Chapter 3.

All Road Guide Signs are fabricated using a common method of assembly with the thickness of the Alumalite aluminum composite panel material, diameter of bolts, and weight of composite section rails (aluminum angle) being the same. Based on size of panel, variations include the dimensions and number of upright timbers, the number and frequency of aluminum angle rails, and size of footing. The Panel Fabrication Charts for each legend can be found in Chapter 4:

- *Road Guide Sign Assembly Reference Diagram on pages 4.1-5, 7, 9*
- *Road Guide Sign Rail and Post Location Diagram on pages 4.1-6, 8, 10*

Select the correct specification based on height and width of panel, not to exceed the value shown in the chart. For example, if the sign has a 6" primary legend, and the panel is 140' wide and 43" tall, the correct assembly reference is 144" wide by 48" tall. Based on this size, the components of this sign assembly will be:

- Alumalite panel with one vertically aligned pin joint to create 140" continuous sheet with optional aluminum panel of same size attached depending on type of sheeting used
- Two aluminum angle rails horizontally located 6" from top and bottom of panel
- Three 4" x 8" posts with the outboard posts set 24" from the left and right sides of the panel, and one in the middle, with aluminum angles attached to match plate angles on back of Alumalite panel
- 18" x 18" by 4'-0" footing

### 3.1 Alumalite Sign Panels

Panel shall be fabricated from Alumalite aluminum composite panel material (ACM) as manufactured by Laminators, Inc., Hatfield. Pa. Panels are premium grade polyolifin core with double layer of fluting and with 0.012" skin of aluminum laminated to front and back sides. Surface of panel shall be flat and free of buckles, warps, dents, burrs, and any fabrication defects.

Use a continuous, un-spliced panel wherever possible. Panel splices are to be made on the vertical alignment with the interior fluting oriented in the horizontal direction. Standard panel sizes include: 4'-0" x 8'-0", 4'-0" x 10'-0",4'-0" x 12'-0", and 5'-0" x 10'-0". Recommended method for joining panels are provided on pages 5.1-23, 5.1-25, and 5.1-27.

### 3.2 Finish

Panels to be finished with factory applied polyester paint finish on front and back. Back panel to be Regal Bronze (HA), and front to be factory finished white. Panel shall be 10mm thick. Panel finished dimensions shall have a tolerance of ± .125". No cleats or joints shall be permitted for panels with a dimension smaller than or equal to 10'-0" (304 cm) in overall width and less than 5'-0" (152 cm) tall, or less than 10'-0" (304 cm) in overall height and with width not less than 5'-0" (152 cm).

### 3.3 Corners

Panels shall have 0.375" safety corner radius unless otherwise specified.

### 3.4 Cutting

All cuts shall be made with high-speed saws. Rotary saw blades to be carbide tipped. Power saws shall have little or no set and as much lead as possible. Blades on table saws shall not extend more than 1" and not less than 0.5" through panel. Panels will be fed through slowly to avoid damage to edges.

### 3.5 Storage

Panels to be stored shall be stacked flat and raised from the floor with supporting 4" x 4" blocking placed 24" on center in an enclosed and well-ventilated area; do not store on concrete surfaces.

### 3.6 Edge Joining Large Panels

All pin joints are to be placed in the vertical orientation. Panels that are wider than 10'-0" and taller than 5'-0" will be vertically pin jointed with Omega Alumalite dowel pins. Joining diagrams are provided in the fabrication drawings showing how each panel is to be joined based on overall size.

Pins to be embedded to an equal depth in each receiving side with outboard pin being 1" from edge of panel and intermediate pins placed one every 12" over the length of the joint.

Refer to Road Guide Sign Fabrication drawings for dowel pin joint fabrication detail.

# 4
# Aluminum Angle Fabrication

### 4.0 Introduction

Each assembly requires two to three pairs of 2-1/2" x 3" x 1/4" structural aluminum (6061-T6) angles placed horizontally on sign panel.

Aluminum angles to be painted prior to attachment to back of Alumalite sign panel.

### 4.1. Road Guide Signs

#### 4.1.1 Finishing

Remove all sharp edges or machine burrs on end prior to painting. Remove any surface imperfections that will prevent a positive adhesive bond to back of Alumalite sign panel. Remove machine oil and dirt on angle prior to painting.

#### 4.1.2 Length

Angles are to be 4" less than overall width of finished panel and placed 2" inboard on both right and left sides of panel.

#### 4.1.3 Assembly and Mounting Holes

The pairs of angles are bolt-attached on the 3" face to create a composite structural section after sign is fully assembled.

- *Composite Structural Section:* Each angle will be fabricated to receive 7/16" mounting holes placed 24" (+/- 4") on center over the length of the 3" face for match plate attachment, with outboard hole on each end placed 4" from end of angle. To insure alignment of common holes, each set of angles shall be fabricated as a pair.
- *Panel Attachment:* The leg of the angle to be attached to the sign panel back to fabricated to receive 1/4"" mounting holes for sheet metal screws placed 24" (+/- 4") on center over the length of the 3" face for match plate attachment, with outboard hole on each end placed 4" from end of angle.
- Clean the unpainted 2-1/2" face intended for attachment to Alumalite panel with *Bar Keepers Friend* brand cleaner (includes oxalic acid to remove surface corrosion), rinse with clean water and wipe dry with a clean cloth. Mark angle attachment location on back of panel. Place bottom of upper angle 6.25" from top of panel and, and place bottom of lower angle 3.75" from bottom of panel. Third angle, if required to be placed equal distant between the upper and lower angle.
- Clean back of Alumalite panel with *Fantastic* brand (no bleach) cleaner and wipe dry with a clean cloth prior to adhesive attachment of angle. Apply 2 continuous 3/16" dia. beads of specified adhesive to 2.5" unpainted face of angle. Beads of adhesive to be 3/4" from edge of angle on each side. Attach angle to back of sign panel. For precise alignment, it is recommended that blocking be affixed to back of panel on the base lines. Firmly press the angle to the panel to compress the adhesive evenly. Carefully secure angle with sheet metal

screws (do not over tighten). Allow attached angles to cure for 24 hours before placing any stress on the connection point.

- *Post Attachment:* Angle attached to post shall receive two to three 5/8" diameter holes to receive 1/2" hex bolt from timber post. Location and number of mounting holes to be based on width of sign panel and number of posts. *Refer to Road Guide Sign Rail and Post Location Diagram* in Section 4 to determine distance in from end of angle (note that this is 2" less on each end than overall width of sign) and if a center hole is required.

## 4.2 Pathfinder/Boundary Signs

### 4.2.1 Assembly

Each assembly requires one or two pairs of 3" x 3" x 3/16" structural aluminum (6061-T6) angles for attachment of Alumalite panel to upright timber.

Aluminum angles to be painted prior to attachment to back of Alumalite sign panel.

### 4.2.2 Finishing

Remove all sharp edges or machine burrs on end prior to painting. Remove any surface imperfections that will prevent a positive adhesive bond to back of Alumalite sign panel. Remove machine oil and dirt on angle prior to painting.

### 4.2.3 Length

Angles are to be 2" less than overall height of finished panel, and placed 1" inboard of top and 1" inboard from bottom. For size of panel, refer to *Pathfinder Sign Assembly Reference Diagram,* in Section 4.

### 4.2.4 Assembly and Mounting Holes

- The 3" leg of the angle to be attached to the sign panel back to fabricated to receive 1/4" mounting holes for sheet metal screws placed 12" on-center with outboard hole on each end placed 2" from end of angle.
- Clean the unpainted 3" face intended for attachment to Alumalite panel with *Bar Keepers Friend* brand cleaner (includes oxalic acid to remove surface corrosion), rinse with clean water and wipe dry with a clean cloth.
- Mark angle attachment location on back of panel. Identify vertical center of panel and mark angle attachment location on back of panel. For single post assemblies, place each angle 1.75" from left and right side of center line. For double post assemblies, refer to post location drawings included in this specification. Note, 4" post widths are nominal with fin ished width of 3.5".
- Clean back of Alumalite panel with *Fantastic* brand (no bleach) cleaner and wipe dry with a clean cloth prior to adhesive attachment of angle. Apply 2 continuous 3/16" dia. beads of specified adhesive to 3" unpainted face of angle. Beads of adhesive to be 3/4" from edge of

angle on each side. Attach angle to back of sign panel. For precise alignment, it is recommended that blocking be affixed to back of panel on the base lines. Firmly press the angle to the panel to compress the adhesive evenly. Carefully secure angle with sheet metal screws (do not over tighten). Allow attached angles to cure for 24 hours before placing any stress on the connection point.

- *Post Attachment:* Place three 5/16" holes on opposing side angle. Location to be cen tered on 3" face and 1" from top and bottom of angle, with third hole placed equal distant between top and bottom. Hole location to match mounting holes on companion angle.

#### 4.2.5 Finishing

Remove all sharp edges or machine burrs. Remove machine oil and dirt on angle prior to painting.

### 4.3 Traffic Regulatory Signs

#### 4.3.1 Parking Sign Panels

- 15cm x 30 cm x 0.125" Aluminum 6061-T6 alloy for Parking Control Signs
- 22..5 cm x 45 cm x 0.125" Aluminum 6061-T6 alloy for Parking Control Signs
- 30 cm x 60 cm x 0.125" Aluminum 6061-T6 alloy for Parking Control Signs

#### 4.3.2 Dimensional Tolerances

Dimensions for panels shall have a tolerance of ± 0.125", with two 1/4–20 x 2-1/2" threaded aluminum studs welded to back of panel. Location shown in specification drawing.

#### 4.3.3 Painting Panel Back

Back panel of all regulatory and parking control signs to be painted NPS Brown. Prime and paint back and edges of aluminum panel NPS Brown using Matthews Zinc Chromate Primer and Matthews Acrylic Polyurethane Enamel.

Aluminum panel to be cut to specified size and attachment holes drilled before paint application. Do not apply paint to panel face. Complete all paint application before application of sign graphics.

#### 4.3.4 Mounting Holes

5/16" holes place in Parking Control Signs are based on attached panel drawings.

#### 4.3.5 Panel Cleaning

The aluminum shall be thoroughly cleaned and degreased with solvent and dried prior to application of the paint.

Apply primer, and two coats of finish enamel as per manufacturer's specifications. Prime plus paint thickness shall provide a minimum of 2 mils (+/−) 1/2 mil thickness of dry paint film.

Primer and enamel shall be applied and dried at an air temperature of not less than 65 degrees Fahrenheit in a well-ventilated, dust-free, enclosed paint room.

# 5
# Painting

### 5.0 Introduction

Section 5 covers painting for use with Uniguide Roadway Signs.

### 5.1 Road Guide & Pathfinder Signs

All aluminum angles, ***except surfaces to be adhesive applied to back of sign panel*** are to be primed and painted with acrylic polyurethane from Matthews Paint Company (1800-323-6593) 8201 100th Street, Pleasant Prairie, WI 53158.

### 5.2 VOC Alternate

Matthews MAP-VOC (low volatile organic compound acrylic polyurethane) is available for use where VOC compliance is required.

### 5.3 Metal Preparation

All surfaces to be coated should be free of oil, grease, soil, or other contaminant. Surfaces to be dry before application of primer. Tack wipe or remove dust prior to applying pretreatment and priming.

### 5.4 Metal Pretreatment

Apply Matthews Acid Activated PT Filler (74760/74766) to provide superior bonding of primer and finish coat to clean bare metal. Mix with specified activator and apply per manufacturer's specifications to 0.5 to 0.75 mils dry film thickness. Primer can be applied after 30 minutes, or when tack free.

### 5.5 Finish Coat

Spray apply two coats Matthews Acrylic Polyurethane (MAP) enamel, satin gloss finish (number 39A-1A) mixed with MAP Catalyst and appropriate reducers depending on temperature and humidity per manufacturer's specifications. Finish coat to be 1.5 to 2 mils dry film thickness (3 to 4 mils wet film thickness). Finish coat can be applied over Rust Inhibiting White Epoxy Primer within 30 to 60 minutes, or when dry to the touch. If finish coat is applied over 48 hours after primer application, surface should be lightly broken with 400 grit sandpaper for proper adhesion.

### 5.6 Field Touch-up

Matthews Acrylic Polyurethane can be brush or roller applied. For good workability and finished surface quality use Matthews Brushing/Rolling Additive (number 47-444SP). Color tolerance for match shall be 1 unit or less CMC.

### 5.7 Packaging for Shipping

Aluminum angles must be fully protected prior to shipping to eliminate scratches or other surface abrasion in transit.

# 6
# Sign Posts

### 6.0 Introduction

This section covers sign posts for use with Raodway Signs

### 6.1 Road Guide Signs

#### 6.1.1 Materials

Solid posts shall be fabricated from single piece Douglas Fir (pressure treated) Structural Grade, Number 2 Standard and Better timbers pressure- treated with ACQ (Ammoniacal Copper Quat.). Follow Douglas Fir grade lumber grading rules of the Western Wood Products Association. In jurisdictions where Douglas Fir is not available, pressure treated southern yellow pine No.1 or better may be used. Material shall be well- seasoned and free of any defects.

All post sizes may be no more than 1/2" less than nominal dimensions and sanded prior to finishing.

#### 6.1.2 Post Size

Post dimensions and quantity are based on legend size and overall panel size. Refer to *Road Guide Sign Assembly Reference Diagram*, Chapter 4, pages 4.1-4, 6, 8, and *Road Guide Sign Rail and Post Location Diagram, Chapter 4, pages 4.1-5, 7, 9*. based on legend size for post size and quantity.

#### 6.1.3 Post length

Post length will be determined by the height of the sign panel, added to the height above grade level to base of panel (HAGL may vary between 5' and 7' based on sight lines and local conditions noted in the sign schedule), plus embedment depth. Variations in grade or slope of actual sign installation location will be incorporated into the calculation on a site-by-site basis. The basic formula to determine post length is as follows:

*Panel height less one inch (–1") + height to base above grade level + 48" embedment depth of post = post length (+/–) for grade adjustment.*

All completed sign panel and post assemblies must be predrilled and assembled in the shop prior to shipment to check alignment and ensure proper fit once installed.

#### 6.1.4 Post Fabrication

Chamfer top of post 1" on 4" from front edge to back edge to create a slope to reduce moisture retention in end grain of post.

### 6.1.5 Drilling Posts

9/16” bolt holes to be placed in timber posts for attachment of aluminum angle on front face of post. Angle to be attached with 1/2” carriage bolt embedded from back of panel.

### 6.1.6 Location of Mounting Holes

Top hole to be placed 5” from top of post (front to back). Location of bottom mounting hole is determined by subtracting 10” from overall panel height and placing the bottom hole that distance from the center of the top mounting hole. Intermediate angles are to be placed mid-point between the upper and lower holes.

### 6.1.7 Shop Verification of Angles

Prior to installation, preassemble sign on shop floor to verify that matching angles align.

### 6.1.8 Bolts

Angle attached with 1/2”-13 dia. galvanized carriage bolts inserted from back of post in field installation. Length of bolt will vary depending on dimension of post. Attach in field with stainless steel flat washer and stainless steel hex nut.

## 6.2 Pathfinders Signs

### 6.2.1 Post Size

Post dimensions and quantity are a based on panel height and width. Based on primary legend height. Note that the large wide panels will require two posts.

### 6.2.2 Post Length

Post length will be determined by the height of the sign panel (between 16” and 56”), the height above grade level to base of panel (7’-0”), plus embedment depth (4’-0”).

All completed sign panel and post assemblies must be predrilled and assembled in the shop prior to shipment to check alignment and ensure proper fit once installed.

### 6.2.3 Post Fabrication

Chamfer top of post 1” on 4”from front edge to back edge to create a slope to reduce moisture retention in end grain of post.

### 6.2.4 Mounting Location for Panel Attachment

Three 3/8” bolt holes to be placed in side of timber posts for attachment of aluminum angle to post. Angle to be attached with 1/4”-20 x 4-1/2” hex bolts. Top hole to be placed 4” from top of post (side to side). Use drilled mounting angle as a reference template for each different assembly.

### 6.2.5 Mounting Location for Stabilizer Blade Attachment

Three 9/16” holes placed front to back measured from bottom of post. See fabrication drawing for location.

### 6.2.6 Shop Verification of Angles

Prior to installation, preassemble sign on shop floor to verify that matching angles align.

### 6.2.7 Bolts

Angle attached with 1/4”-20 x 4-1/4” stainless steel hex bolts inserted from side of post in field installation with stainless steel flat washer on each side and stainless steel hex lock nut.

## 6.3 MUTCD Regulatory & Warning Signs

### 6.3.1 Materials

4” x 4” Pressure treated-Douglas Fir No. 2 or better, or pressure-treated southern yellow pine

Timber posts may be used as an alternate. For standard traffic signs, use posts no smaller than nominal 4” x 4” with use of 5-1/2” assembly bolt if the assembly includes an HDO plywood panel, and 4-1/2” long assembly bolt if sign is an aluminum instead of the 2-1/2” specified for steel tube mountings. Use of timber for any Traffic Regulatory and warning sign larger than 30” x 30” will require engineering based on species of wood, size of sign, and mounting height. Refer to engineering criteria in Section 4.1, Appendix B of the General Requirements specification.

Pressure-Treated 4” x 4” Douglas Fir or southern yellow pine, No. 2 or better

- 15 cm x 30 cm, Parking Control Signs with 4’-0” height above grade, (8’-0” post)
- 22.5 cm x 45 cm with 6’-0” height above grade, (10’-0” post)
- 30 cm x 60 cm  Parking Control Signs with for 7’-0” HAGL, (12’-0” post)
- Traffic Regulatory Signs, standard height is (7’-0” to base + panel size + 36” embedment)

### 6.3.2 Post length

See Steel Post

### 6.3.3 Drill Post

Drill two 5/16” holes in post for panel attachment. Locate holes to correspond to holes in regulatory sign panel. For Parking Control Signs, refer to panel layout drawing in this section with holes located away from legend.

### 6.3.4 Post Finishing

Chamfer top of post away from face to allow runoff of rain water.

## 6.4 Steel Posts

### 6.4.1 Traffic Regulatory Signs

Square tubular sections weathering steel A 847, in the following section sizes:

- 15 cm x 30 cm, Parking Control Signs with 4’-0” height above grade, (8’-0” post)
- 22.5 cm x 45 cm with 6’-0” height above grade, (10’-0” post)
- 30 cm x 60 cm, Parking Control Signs 2” x 2” x 1.8” x 11’-0” (for 7’-0” HAGL)
- Traffic Regulatory signs  3” x 2” x 1.8” (length varies depending on panel height)

### 6.4.2 Post Length

Determine post length on a site-by-site basis. Variables include actual height of sign above grade. Height may vary between 5’ and 7’ depending on location and type of sign, height of panel based on panel size, and variations in grade or slope of actual sign installation location (panel height + height to base above grade level + embedment depth of post = post length (+/−) for grade adjustment). Embedment depth to be 36”.

### 6.4.3 Drill Post

Drill two (2) 5/16” holes in post for panel attachment. Locate holes to correspond to holes in Traffic Regulatory Sign panel. For Parking Control Signs, refer to panel layout drawing in this section with holes located away from legend.

### 6.4.4 Metal Finishing

All posts to be cut square. Finish of cut to be free of edge burrs or saw tooth on cut edge.

# 7
# Stabilizer Blades

### 7.0 Introduction

Stabilizer Blades are posts mounted by direct embedment.

### 7.1 Pathfinder & Boundary Signs

#### 7.1.1 Material

0.25", A-36 steel plate  mounted to timber uprights that are directly embedded without cement to reduce lateral movement or loosening of sign in its mount.

#### 7.1.2 Size

All stabilizer blades are 42" long.  Width corresponds to size of post:

| ***Post Size*** | ***Blade Width*** | ***Screw Length*** | ***Footing Width*** |
|---|---|---|---|
| 4" x 4" | 10" x 42" | 5" | 12" |
| 4" x 6" | 12" x 42" | 7" | 14" |
| 4" x 8" | 14" x 42" | 9" | 16" |
| 6" x 8" | 18" x 42" | 9" | 20" |

#### 7.1.3 Fabrication

3 holes, 9/16" vertically centered holes in plate at locations shown in drawing.

#### 7.1.4 Finish

Remove all sharp edges and burrs from cutting and drilling of parts. Clean metal and paint with two heavy coats of alkyd based metal primer, or finish by-hot dipped galvanizing.

#### 7.1.5 Assembly

Refer to assembly and installation instructions in Section 5.1.

# 8
# Graphic Layout and Production

### 8.0 Introduction
This section covers graphic layout and production for Roadway Signs.

### 8.1 Requirements

#### 8.1.1 Computer Cut Graphics
Road/Highway Guide, Pathfinder, and Boundary signs to be computer cut from vector art files created in Adobe Illustrator, Freehand MX, or other compatible programs. Finished cut graphics must precisely match digital copy and scaled print relative to measurements of typeface replication, stroke width, letterspace, and symbol and arrow size. Letter stroke to be a continuous line with no ragged edges or ragged interior corners. Prismatic sheeting is difficult to cut on many printer/plotter machines because of both the thickness and composition of sheeting material. Computer cutting prismatic materials should not be required when using specified overlay films.

#### 8.1.2 Screen-Printed Graphics
Overbar graphics for Pathfinder and Boundary Signs to be screen- printed on white Type II retroreflective sheeting. Files with National Park Service name and NPS Arrowhead logo to be provided in rasterized or vector art, TIFF, EPS PostScript file. Finished cut graphics must precisely match digital copy and scaled print relative to measurements of typeface replication, stroke width, letterspace, and symbol and arrow size and proportion. Letter stroke to be a continuous line with no ragged edges or ragged interior corners.

### 8.2 Graphic Layout

#### 8.2.1 Grid Format
All graphics to be formatted using National Park Service Road Guide Sign grid formats (RG.1-11, HG.1-3, PF.1-4, PB.1-4) as specified in this manual. This includes type size, kerning, margins (left and right), top alignment, and overall panel proportions.

#### 8.2.2 Typography
Legends to be NPS Rawlinson Roadway with Clearview Highway for secondary legends. All sign legends are to be prepared using the typographic specifications provided in Chapter 2, Graphic Standards.

#### 8.2.3 Production Layouts
Graphics for each sign will be provided with all text and graphic elements in position. Graphics to be accurately reproduced from these files.

## 8.3 Artwork & Imaging

### 8.3.1 Art Preparation

All artwork for panels will be provided as a vector art computer file in electronic format with Adobe Illustrator or Freehand MX files with all type, arrows, and symbols in-position following the established typographic specifications and grid formats. Allowable reproduction tolerance is (+/−) 0.0312" for typographic reproduction of all letters.

### 8.3.2 Art Approvals

To insure proper conversion from digital files supplied, all art to be reproduced shall be submitted to the COTR (or whomever is designated in the review process) for approval before sign is fabricated. Submissions are to be outline plots from cutting files (10% scale or 20% scale).

## 8.4 Graphic Material/Production Methods

### 8.4.1 Retroreflective Sheeting with Transparent Overlay

All Road Guide Signs to be produced with retroreflective background with computer (reverse) cut brown (or blue for specific concession related signs) transparent adhesive overlay film applied to the white sheeting, with all graphics (including secondary legends) and borders cut in-position from the approved sign layout graphic file.

Secondary legends are to be cut in positive from yellow retroreflective sheeting that is compatible with the grade of white base sheeting, and are to be cut and applied over the secondary legend (reverse cut white) after the transparent overlay films are applied. All graphics to be computer cut as a continuous graphic that is weeded and applied using compatible application film with all graphics in-position.

### 8.4.2 Retroreflective Sheeting placed on Retroreflective Sheeting

An alternate method for preparing Road Guide Signs is to place computer cut retroreflective graphics on a retroreflective base material using application tape to maintain alignment and spacing of word groups. This method requires careful positioning of each graphic onto the panel based on the layout grid formats and the specific sign panel layout drawing (see *Graphic Application)*.

### 8.4.3 Screen- Printed Graphics, Retroreflective Sheeting with Transparent Overlay

Screen-printing is specified for the dark green opaque overbar portion of Pathfinder and Boundary Signs with white "National Park Service" name and the NPS Arrowhead logo as a separate (Brown, PMS-1615) screen- printed graphic cut to the specified outline shape. These two graphics will be applied to a white retroreflective background. Graphics for the site-specific

message will be prepared as a reverse cut brown transparent overlay that is applied over the white sheeting.

### 8.4.4 Screen-Printing on Retroreflective Sheeting with Aluminum Sign Panel

Screen-printing may be used to make Parking Control Signs that are reproduced in multiples. The decision to use screen-printing versus computer cut and applied legends should be based on which method is most cost effective for the number of signs required.

### 8.4.5 Material Selection

Selection of applicable grade of retroreflective sheeting will be determined by the NPS based on desired life cycle and brightness requirements. Retroreflective materials shall comply with Standard Specifications for Construction of Roads and Bridges on Federal Highway Project, FP-96 and ASTM D4956-01. The following three standard sheeting types are used. Refer to Section 6.2: *Sign Materials Reference Selection Guide*.

- Type I – A medium-intensity retroreflective sheeting referred to as "engineer grade" with Class 1 adhesive backing that is pressure sensitive per ASTM 4956-01 and FHWA standard specification FP-96.
- Type II – A medium high-intensity retroreflective sheeting referred to as "super engineering" FHWA standard specification FP-96.
- Type III – A high- intensity retroreflective prismatic sheeting material with Class 1 adhesive backing that is pressure sensitive, per ASTM 4956-01 and FHWA-FP-96.

Transparent overlay film shall be warranted by the reflective sheeting manufacturer for the life of the retroreflective sheeting.

### 8.4.6 Traffic Regulatory Signs

All adhesive graphics for this type of sign will have Type 11 retroreflective background and legend except for black legend and graphics which will be nonreflective as specified below. Background for Parking Control Signs shall be Type 11, Super engineering grade, premium quality, wide angularity enclosed lens retroreflective material to meet or exceed the standards of: GSA L-S-300-C, Reflectivity 1, or FHWA Standard Specifications FP-85 Sections 633.06 and 718.01. These colors are specified using Avery Dennison product numbers. If an alternate manufacturer is used, notify Contract Officer with verification that grade and adhesive system are equal.

| **Colors:** | **Type 11 for aluminum** | **Type 11 for wood** |
|---|---|---|
| White | T-2500 | T-2200 |
| Red | T-25022 | |
| Green | T-2507 | |
| Blue | T-2505 | |

Translucent inks to be compatible with specified sheeting following manufacturer's specifications.

Premium quality, opaque pressure sensitive material designed for electro-cutting. Material shall be 2 mil thick with an outdoor life of 5-7 years.

## 8.5 Color Use

### 8.5.1 Colors

Colors shall be used as specified in Standard Highway Sign Colors (FHWA, HTO-21). These colors are specified using 3M and Avery Dennison product numbers. If an alternate manufacturer is used, notify Contract Officer with verification that grade and adhesive system are equal to the specified materials below.

Standard Road Guide Signs are to be brown with white legend. Signs guiding visitors to fee areas managed by a concession are to have a blue background and white legend. For questions on the appropriate use of color, contact the UniGuide Program Manager.

Method A: Computer Cut Transparent Overlay Film Applied on to White Retroreflective Sheeting

| | Manufacturer | White Background | Brown Transparent Overlay | Blue Transparent Overlay |
|---|---|---|---|---|
| Type I Material (Engineer Grade) | Avery Dennison 3M 3290 | T-1500 White 1179 1175 | OL-2009 | OL-2005 |
| Type II Material (Super Engineer Grade) | Avery Dennison 3M | T-2500 White na | OL-2009 na | OL-2005 na |
| Type III Material (Prismatic) | Avery Dennison 3M | T-6500 White na | OL-2009 na | OL-2009 na |

Method B: Computer Cut White Retro-reflective Sheeting Applied over Retroreflective Base Sheeting

| | Manufacturer | White Legend | Brown Background | Blue Background |
|---|---|---|---|---|
| Type I Material (Engineer Grade) | Avery Dennison 3M | T-1500 White 3290 | T-1509 Brown 3279 | T-1505 3275 |
| Type II Material (Super Engineer Grade) | Avery Dennison 3M | T-2500 White na | T-2509 Brown na | T-2505 na |
| Type III Material (Prismatic) | Avery Dennison 3M | T-6500 White na | T-6509 Brown na | T-6505 na |

Note 1: Sheeting material lines identified with (na) are not available from the manufacturer noted.
Note 2: Type 1, 11, and 111 are designations of ASTM and the Federal Highway Administration and define materials based on performance specifications.

### 8.5.2 Compatibility of Graphic Sheeting

Background and legend shall use sheeting from the same supplier. Supplier shall guarantee its products as a composite sign.

### 8.5.3 Age of Material

No more than 12 months shall have elapsed from the date of purchase from the manufacturer to the date of application on the substrate.

## 8.6 Screen-Printing on Retroreflective Sheeting

### 8.6.1 Artwork & Imaging

Screen- printing contractor shall produce film positives and negatives as required from the electronic art files as supplied for 175 line (or finer) screen production in the format for intended reproduction.

### 8.6.2 Printing Production

All screen work shall be of high quality, with clean, crisp, and clear graphic definition. All line work to be have even resolution from 1/2 point line width or heavier.

### 8.6.3 Colors

Colors shall be:

- Dark Green, PMS-5605 for Overbar place on Pathfinder and Boundary Signs
- NPS Brown, PMS-1615 for NPS Arrowhead logo graphic line art

Ink type shall be specified as compatible by the manufacturer of the retroreflective substrate. Inks shall be formulated using a computer calorimetry system and shall be matched with a tolerance of + 0.1 grammes.

### 8.6.4 Formulation Cards

Actual samples of selected colors shall be filed for each individual ink color to ensure consistency of the product. Filed information shall include, but is not limited to, ink formula with designated color code, thinner and retarder adjustments in grammes, batch numbers of inks, thinner and retarder, mesh tension, emulsion coating and exposure units/time. When semi- or fully- automatic equipment is used, additional information shall be filed for: off contact, peel, speed, squeegee, flood speed, curing temperature, and belt speed.

Thinner and retarder used in the adjustment of the inks shall be specified by the ink manufacturer. Additions shall be made by weight with a tolerance of (+/−) 0.1 gram and filed on the formulation card.

Screens shall be 254 polyester monofilament, mesh tensioned to no less than 18 newtons. Mesh tension, emulsion coating and exposure units/time are to be established and filed on the formulation card.

Printing shall be performed on semi- or fully- automatic equipment with a repeatability tolerance of (+/−) 0.004" in conjunction with a forced air conveyor drier. Off contact, peel, speed,

squeegee, flood speed, curing temperature, and belt speed are to be established and filed on the formulation card. A fiberglass laminated urethane squeegee set at a 75° angle is to be used.

## 8.7 Graphic Application

### 8.7.1 Quality

Application of pressure-sensitive sheeting shall follow manufacturer's specification. No loose or curled or lifting edges, bubbles, or blisters shall be permitted.

### 8.7.2 Surface Preparation

Before application of the sheeting, the face shall be free of all foreign matter such as paint, dust, or chemical residue. Alumalite panel shall be dry and free of any dirt or surface imperfection. The aluminum shall be thoroughly cleaned and degreased with solvent and alkaline emulsion cleaner by immersion, spray, or vapor degreasing and dried prior to application of the sheeting coat.

### 8.7.3 Background Material

Panels shall be covered with one unspliced sheet unless the dimension is larger than 48" in vertical direction. Horizontal splices shall be positioned so as not to fall within legends. Top piece shall overlap bottom piece by a minimum of 0.5", but not more than 0.75". Spliced sheets shall be color matched.

Background shall be adhered to front of sign panel prior to application of sign graphics.

### 8.7.4 Production Method A

Apply transparent overlay graphics as one continuous sheet, or multiple sheets with overlay splice to white retroreflective sheeting background. Use application film with border dimensions as specified in the layout grid format for the specific size of sign. Overlay splice to be incorporated into cutting files to eliminate any distortion of finished graphic.

### 8.7.5 Production Method B

Apply computer cut retroreflective graphics to brown or blue retroreflective background with application film.

### 8.7.6 Legend, Border Application

Legend shall be adhered to background after application of background sheeting to sign panel. Graphics to be applied as contiguous sections with all type and graphics in- position using sheeting manufacturer's recommended transfer tape.

### 8.7.7 Horizontal Alignment

Using formats supplied, letters shall be horizontally aligned to a tolerance of (+/−) 0.125" from side of panel to left edge of legend with standard adjustments for round or overhanging letters. Inter-letter spacing shall be horizontally aligned to a tolerance of (+/−) 0.0625" from letter to letter and (+/−) 0.5" overall based on the typographic specifications in this manual.

### 8.7.8 Vertical Alignment

Using formats supplied, letters shall be horizontally aligned to a tolerance of (+/−) 0.125" from top of panel to baseline of legend, or from baseline to baseline of multi-line legends. Optical adjustment for overhang of round letters will be maintained as set on the computer.

### 8.7.9 Production Method C

Place white retroreflective sheeting on full panel. Apply screen-printed dark green overbar panel in upper section with white border as specified and NPS identifier in specified flush left position. Apply correctly sized die cut, screen-printed NPS Arrowhead logo in overbar as specified. Based on Production Method A, apply transparent overlay graphics as one continuous sheet to primary area of panel with white border and rule as specified. Following graphic application, attach edge cap as specified below.

# 9
# Assembly

### 9.0 Introduction

All completed sign panel and post assemblies must be predrilled and assembled in the shop prior to shipment to check alignment and ensure proper fit once installed.

If post and panels are assembled separately, aluminum angles shall be manufactured with the 10 mm Alumalite  sign panels to ensure correct alignment of 3/8” bolts to attach angle to panel and the matching holes in the angle

### 9.1 Assembly and Installation

For complete specifications on assembly and installation, refer to the UniGuide Field Manual.